> theories of the molecularists* on the one hand, and of Mr. Darwin on the other, once for all established. The three modes of theorising indicated, indeed, are not without a tendency to approach one another; and it is precisely their union that would secure a definitive triumph for the doctrine of materialism. Mr. Huxley, as we have seen—though what he desiderates is an autoplastic living *matter* that, produced by ordinary chemical processes, is yet capable of continuing and developing itself into new and higher forms—still begins with the egg. Now, the theory of the molecularists would, for its part, remove all the difficulties that, for materialism, are involved in this beginning; *it would place protoplasm undeniably at length on a merely chemical level; and would fairly enable Mr. Darwin, supplemented by such a life-stuff, to account by natural means for everything like an idea or thought that appears in creation.*

Nothing could be more outspoken and candid than this utterance of Mr. Stirling. He evidently believes that such doctrines of the "molecularists" concerning the new evolution of living things will have long to "await the proof"; but we, on the contrary, firmly believe the time to be not far distant when this will be as much an accredited dictum of science as are the other doctrines of the Correlation of the Physical Forces, and of the Correlation of the Vital and Physical Forces which have been its necessary predecessors. We would ask the Transcendentalists, at least, to speculate upon the possibility of this. Let them learn in the meantime how they may best readjust their doctrines, so that when the time comes in which such change will be absolutely necessary—if their views are to be in accordance with the established truths of science—there may be no sudden bewilderment, no feeling as if the very ground were being swept from underneath their feet. To such a thinker as Mr. Stirling, we should imagine the necessary modification of doctrine would not prove difficult. For, after all, the acceptation, to the fullest extent, of the doctrines concerning Life to which we have been alluding, involves, even from the Transcendentalists, only a somewhat different point of view. So long as Matter, and Force or Spirit, are but two aspects of a something one and indivisible, there is still room for opposite philosophical systems. The old questions may be discussed as earnestly as ever by those who have the leisure and the taste for such ontological inquiries. And, if perchance lured into such discussions, it would often be found that he who was most vehemently charged with Materialism would, from an ontological point of view, prefer to rank himself amongst those who professed the principles of a pure Idealism.

H. CHARLTON BASTIAN

AGRICULTURAL CHEMISTRY

How Crops Grow: A Treatise on the Chemical Composition, Structure, and Life of the Plant, for Agricultural Students. By Samuel W. Johnson, M.A., of Yale College, U.S. Revised, with numerous additions, and adapted for English use, by A. H. Church and W. T. Thiselton Dyer. 1 vol. 8vo., pp. 399. (London, 1869.)

THIS revised edition of an excellent American work ought to find its way into the hands of a very numerous class of youths whose future avocations will require a special acquaintance with the phenomena concerned in the growth of plants—either naturally or under the influence of cultivation—some familiarity with the general structure of plants, with the functions of their several organs and the nature of the various materials which it is the work of vegetation to produce for the food of animals and for numerous other purposes.

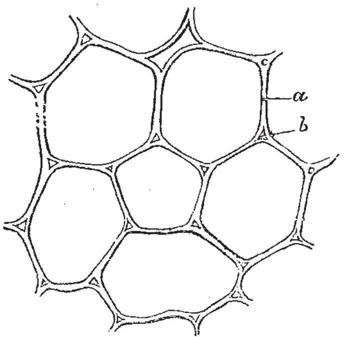

Fig. 1.—Section of cells in a cabbage stem, shewing at *a* the union of the cell-walls and the intercellular spaces at *b*.

It is surprising that in a country where the practice of agriculture is one of the chief sources of wealth and is, directly or indirectly, the means of employing a vast amount of capital and labour, very little should have been done towards the scientific elucidation of agricultural practice so as to ensure improvement of the art. Yet such is still the case in this country with some rare exceptions like the experimental farm at Rothamsted, where Messrs. Lawes and Gilbert have done so much to aid the farmer in applying manures and cattle-feeding materials to the best advantage. The Royal Agricultural Society, the Highland Agricultural Society, and the Agricultural College at Cirencester, have also contributed towards the attainment of the same object; but, as a rule, agriculture is practised almost exclusively under the guidance of mere traditional principles and habitual routine, without those engaged in this business having any appreciation of the phenomena and natural laws which govern the growth of plants, even so far as they are known to science. This fact is, in part, no doubt a consequence of the general disregard of scientific teaching in this country; but it is also referable in some degree to the absence of any organised scientific investigation of plant-life in relation to agriculture, such as that carried on of late years in Germany by the aid of the various governments and with the hearty support of farmers. It is indeed strange that in a country like ours, where agriculture is no longer a mere

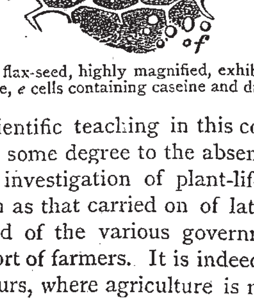

Fig. 2.—Section of a flax-seed, highly magnified, exhibiting *a* cells containing mucilage, *e* cells containing caseine and drops of oil *f*.

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* Mr. Stirling so designates those who believe in the possibility of an evolution of living things; or, in other words, those who believe in the possibility of a so-called "spontaneous generation."

gathering of the natural produce of the earth, but has become, more thoroughly than elsewhere, the art of manufacturing food, there should not be an activity in the teaching and prosecution of agricultural science proportionate to that existing where agriculture is in a more primitive state.

However, a beginning is being made in this direction, and it is to aid students in acquiring a knowledge, both technical and scientific, of the less obvious aspects of plant-life, that the volume mentioned above has been written. The classification of the subjects treated of is adapted both to this object and to the wants of the lecture-room, while the illustrations of particular phenomena are in all cases chosen with reference to agricultural practice.

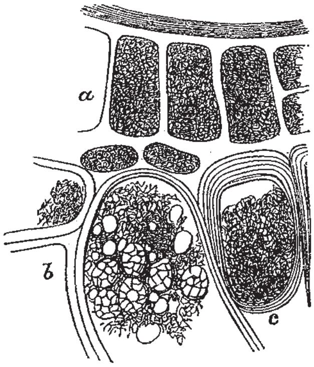

Fig. 3.—Section of outer cells of an oat grain; *a* and *c* containing chiefly caseine, and *b* starch granules.

The first division is devoted to the chemical composition of the plant. Here the elementary substances of which plant organs and their materials consist are briefly described, chemical force is defined and the technical language of chemistry explained; then follows an account of the characters and composition of substances which are common products of vegetation in all its forms, of others which are more or less peculiar to certain plants; and lastly, the important subject of the ash of plants is discussed in regard to its general and special character, the extent to which its constituent parts are accidental or essential, and the functions it or its several parts may perform in the growth and development of the plant.

The special organized forms in which the common materials of plants present themselves are well illustrated by numerous woodcuts, of which figs. 1, 2, 3, and 4 will serve as examples.

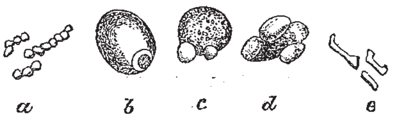

Fig. 4.—Forms of various albuminoid grains; *a* from vetch seed; *b* from the castor bean; *c* from flax seed; *d* from *Myrica Cerifera;* and *e* from the aril of the nutmeg.

Copious references to special investigations and monographs are given throughout this division of the book; but unless we have credit for doing even less than has been done in this country, it would seem that the references are too exclusively to German authorities. Only in one instance are the elaborate observations of Lawes and Gilbert mentioned (p. 316), and French experimenters are also but rarely referred to.

One excellent feature of this division consists in the tabulated statements of the amounts of particular constituents contained in various plants, in a form that will be not only instructive to the student, but very useful for reference.

The second division deals with the structure of the plant, the offices of its organs, the nature of the plant cell, the organs of nutrition and of reproduction, with their several functions.

The third division treats generally of the life of the plant, describes how the seed germinates, what is the food of plants, how it is taken up, the nature and the motion of the sap and the various forces by which this is influenced, the mode of reproduction, and, lastly, the death of the plant.

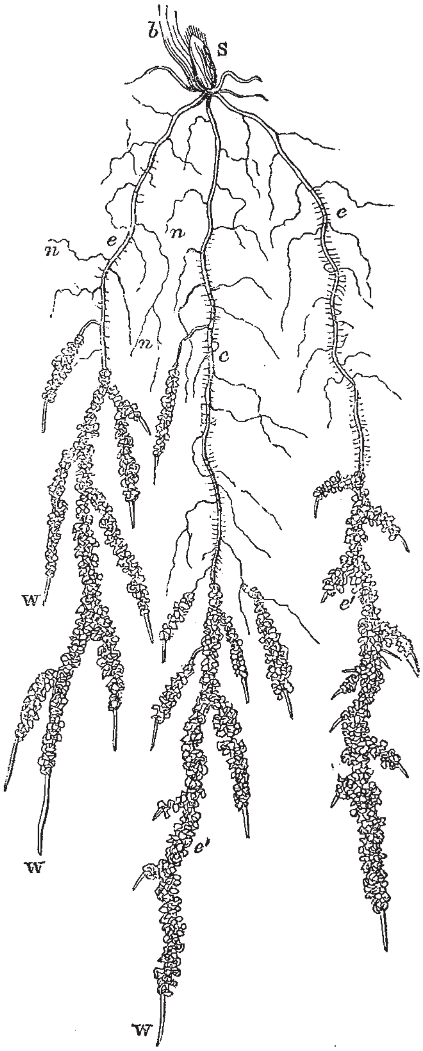

Fig. 5.—Young wheat plant with earth adhering to roots at *e′*, while the root tips W, and the other parts of the primary roots *e*, and of the secondary roots *n* are bare. *S* is the seed and *b* the blade.

Then follows an appendix, with copious tables of the composition of agricultural plants and products, cattle feeding materials, &c., which cannot fail to be useful.

The first and third divisions of this work seem unexceptionable; but the more purely botanical portion might be improved by revision, thus, for instance, at p. 178, cystoliths and crystallised concretions in plant-cells are treated of in a manner which suggests want of familiarity with the microscopic examination of plants, and is calculated to make a beginner suppose all the crystalline concretions of plants are cystoliths of some sort.

At p. 216, it is stated that "In some cases, cells consist only of protoplasm and nucleus, being destitute of cell-walls during a portion or the whole of their existence," and a single line might have been added to explain the exceptional conditions under which these cells—that are not cells—present themselves. Again, at p. 218, after the passage "many cells are altogether empty, and consist of nothing but the cell-wall," there might have been added "after cessation of the functions."

The Screw pine referred to at p. 227 is not a palm; and while the term "imbricated buds" is awkward, the reference, on the same page, to roots that have no buds seems to suggest that buds are generally present on roots inconsistently with what precedes.

Before concluding the notice of this work we must refer to one part of the introductory chapter, where the author very justly condemns as a delusive error the notion that there is any opposition or conflict between science and art, or between theory and practice. "They are, as they ever have been, and ever must be, in the fullest harmony. If they appear to jar or stand in contradiction, it is because we have something false or incomplete in what we call our science or our art; or else we do not perceive correctly; but are misled by the narrowness and aberrations of our vision. It is often said of a machine, that it is good in theory, but fails in practice. This is as untrue as untrue can be. If a machine fail in practice, it is because it is imperfect in theory. It should be said of such a failure—the machine was good, judged by the best theory known to its inventor, but its incapacity to work demonstrates that the theory had a flaw."

It is the boast of some who affect to glory in the sufficiency of practice and to decry theory, that the former is based upon experience, which is the only safe guide. But this is a one-sided view of the matter. Theory is also based upon experience, if it be truly scientific. The vague surmise of an ignorant and undisciplined mind is not theory. Theory, in the proper and good sense, is always a deduction from facts—the best deduction of which the stock of facts in our possession admits. It is the interpretation of facts. It is the expression of the ideas which facts awaken when submitted to a fertile imagination and well-balanced judgment.

If the appreciation of these views were at all equal to their truth, and if the importance of their bearing on the advancement of agriculture were at all adequately recognised, there would probably be little reason to lament the want of attention either on the part of the farmer or the statesman, to the scientific aspects of that pursuit, and less scope for that blatant obstructive, the "practical man," who shuts his eyes and ears against everything his grandfather did not know of, believes only in the folly of wisdom, and is supremely happy in his own ignorance.

OUR BOOK SHELF

A Geographical Handbook of all known Ferns, with Tables to show their Distribution. By K. M. Lyell. (Murray, 1870.)

THIS useful and unpretending, but elegant little volume, consists of two parts. In the first, the genera and species of ferns are enumerated under a number of geographical divisions and subdivisions, which appear to have been judiciously selected. The stations, habitats, and geographical range of each species, are given with much care, and the authorities fully quoted. It thus forms a series of fern catalogues for eighteen divisions of the globe. The second part consists of a systematic list of all the species, with their range of distribution indicated in eighteen columns. Sir William Hooker's arrangements and limitations of species have been followed throughout, and this gives a unity to the work which has its value. But as ferns have generally so wide a range that genera restricted to any one part of the globe are exceptional, we think it would be as well in a work of this nature, to adopt the additional genera of John Smith and others.

We would also suggest for another edition, that a summary of the genera and species might be usefully given at the head of each geographical subdivision. Thus for "Europe Proper" we should have:

1.	Woodsia	2	species
2.	Dicksonia	1	,,
3.	Hymenophyllum	1	,,
4.	Trichomanes	1	,,
5.	Davallia	1	,,
6.	Cystopteris	4	,,
7.	Adiantum	2	,,
8.	Cheilanthes	3	,,
9.	Cryptogramme	1	,,
10.	Pteris	4	,,
11.	Lomaria	1	,,
12.	Woodwardia	1	,,
13.	Asplenium	17	species
14.	Scolopendrium	2	,,
15.	Aspidium	2	,,
16.	Nephrodium	6	,,
17.	Polypodium	4	,,
18.	Nolhochlæna	2	,,
19.	Gymnogramme	2	,,
20.	Osmunda	1	,,
21.	Ophioglossum	2	,,
22.	Botrychium	5	,,
		55	species

Such summaries would offer useful materials for comparison, and show at a glance what genera were abundant, rare, or wanting, in a given district. We also think the specific names should have been printed with some difference of type, so as more readily to catch the eye; but these are small matters in so useful a work, which must have been a labour of love to its author, and which no lover of ferns should be without. A. R. W.

Agricultural Analysis.—*Agricultural Qualitative and Quantitative Chemical Analysis.* After E. Wolff, Fresenius, Krocker, and others. Edited by G. C. Caldwell. Pp. vi. and 307. 8vo. (New York: Judd. London: Trübner, 1869.)

MR. CALDWELL (Professor of Agricultural Chemistry in the Cornell University) prepared this compilation for the use of his own pupils and agricultural students generally. Many of the chapters consist of translations from Wolff's "Anleitung," and much more is taken from Fresenius's well-known works on analysis. The metric system of weights and measures, and the centigrade thermometric scale are adopted throughout; and a useful, but not sufficiently extensive set of tables is given at the end of the work.

The merit of a treatise of this kind consists in a proper selection and arrangement of materials; and Prof. Caldwell seems to have performed his task satisfactorily, though, as he admits, somewhat hastily. It is hardly necessary to add, that the book would be quite as much out of place in the hands of an unassisted student as any of those of which it is an adaptation. Under the guidance of a teacher, however, it would undoubtedly be of much service in an agricultural laboratory.

Jahrbuch der Erfindungen. H. Hirzel und H. Gretschel. (Leipzig: Quandt und Händel, 1869.)

THIS is one of a type of books which is not published in this country, either because our publishers are not sufficiently energetic, or because our public has not as yet